

CLAIMS

1. A semiconductor laser comprising:

- an active region (12) which, in response to a pumping energy applied thereto, can produce a stimulated emission of radiation with a central wavelength ( $\lambda$ ) in the far infrared region, and

- at least one confinement region (16, 18, 22) suitable for confining the radiation in the active region (12) and comprising at least one interface (16a, 16b, 22a) between adjacent layers that is capable of supporting surface plasmon modes generated by an interaction of the interface with the radiation,

characterized in that

the at least one confinement region (16, 18, 22) comprises a wave-guide layer (16) which is delimited on opposite sides by a first interface and by a second interface (16a, 16b), the guide layer (16) being doped in a manner such that the first and second interfaces (16a, 16b) are capable of supporting the plasmon modes, respectively, and the guide layer (16) being of a thickness (d) such as to bring about the accumulation of the plasmon modes in proximity to the first and second interfaces (16a, 16b), outside the layer (16), and substantially a suppression of the plasmon modes, inside the layer.

2. A laser according to Claim 1 in which the plasmon modes of the first and second interfaces (16a, 16b) are mutually coupled.

3. A laser according to Claim 2 in which the wave-guide layer (16) has a dielectric constant ( $\epsilon_1$ ) with a negative real part and is interposed between regions (12, 18) having a dielectric constant ( $\epsilon_2$ ) with a positive real part but with a module substantially of the same order as the dielectric constant ( $\epsilon_1$ ) of the guide layer.

4. A laser according to Claim 3 in which the real part of the sum of the dielectric constants of the guide layer (16) and of the regions (12, 18) between which the layer is interposed is substantially of the order of the imaginary part of the sum.

5. A laser according to any one of the preceding claims in which the active region (12) comprises a quantum-cascade active region.

6. A laser according to Claim 5 in which the active region comprises a structure with GaAs/ $\text{Al}_{0.15}\text{Ga}_{0.85}\text{As}$  superlattices of non-uniform period.

7. A laser according to any one of the preceding claims in which the guide layer (16) is interposed between the active region (12) and a substrate region (18).

8. A laser according to Claim 7 in which the wave-guide layer (16) is in contact with the active region (12).

9. A laser according to any one of the preceding claims, further comprising a first electrical contact region (20) disposed directly on the guide layer (16).

10. A laser according to any one of the preceding claims, further comprising a second electrical contact region (22) disposed directly on the active region (12).

11. A laser according to any one of the preceding claims, characterized in that it produces a stimulated emission of radiation with a frequency of between 1 and 10 THz.

12. A laser according to any one of the preceding claims in which the thickness (d) of the wave-guide layer (16) is of the order of 100 nm.

13. A laser according to any one of the preceding claims in which the wave-guide layer (16) is formed by an n-type semiconductor in which the concentration of electrons is of the order of  $10^{18} \text{ cm}^{-3}$ .